RESPONSES TO STAKEHOLDER QUESTIONS REGARDING THE SJV PM2.5 PLAN
(May 19, 2008)

Q1: What photochemical model was used by the Air Resources Board to prepare the Attainment Demonstration?

The Air Resources Board (ARB) staff used U.S. EPA's Community Multi-Scale Air Quality (CMAQ) model, which is a very complex mathematical representation of our current understanding of atmospheric processes. CMAQ has been thoroughly peer-reviewed and scrutinized by the international scientific community. It is updated annually.

Q2: Does the photochemical model used by the Air Resources Board include the condensable fraction?

Yes, the CMAQ model embodies the current scientific knowledge (that can be represented mathematically) of the fate of organic molecules in the atmosphere, including condensation.

Q3: What criteria were used to evaluate the model performance?

The CMAQ model of the U.S. EPA was used by the ARB to generate ambient concentrations of gaseous and particulate-matter pollutants for every hour of the calendar year 2000. These hourly concentrations were then compared with the rich database of measurements made during the California Regional PM_{10}/$PM_{2.5}$ Air Quality Study (CRPAQS) that took place during the same year. ARB used various statistical measures as well the expert judgments of highly-trained air quality modelers and scientists to gauge the performance of the CMAQ model. The quality of this evaluation was very consistent with what is suggested in the U.S. EPA's modeling guidance.

Q4: Why were additional controls of volatile organic compounds (VOC) not considered in the Attainment Demonstration?

The attainment demonstration modeling does include existing VOC reductions from already adopted controls. However, no new VOC reductions were included, consistent with the U.S. EPA Implementation Rule which does not require VOCs to be addressed unless they are found to be a significant $PM_{2.5}$ precursor. However, we considered this issue further because VOCs can, in principle, contribute to the particulate matter burden in two different ways. First, they can form secondary organic aerosols (SOA) due to atmospheric reactions. Second, they could lead to the production of nitric and sulfuric acids that are the precursors to ammonium nitrate and sulfate, respectively. Our current estimates of SOA formation suggest that secondary aerosols are not a significant contributor to the organic carbon (OC) fraction of $PM_{2.5}$. Ammonium nitrate is formed mainly during the winter months in the San Joaquin Valley, and the formation of nitric acid during the winter is not VOC driven. Thus, additional VOC controls would not be effective in controlling annual $PM_{2.5}$ concentrations in the San Joaquin Valley.

Q5: How were the Relative Response Factors (RRF) calculated?

All RRFs used in the ARB Attainment Demonstration were calculated using a grid-based photochemical model known as the Community Multi-Scale Air Quality (CMAQ) model from the U.S. EPA. More information on RRFs is provided later in this document.

Q5: How were the future-year Design Values (DVs) calculated?

The future-year DVs were calculated in four steps. First, the annual DV for 2006 was calculated according to the U.S. EPA guidance using $PM_{2.5}$ measurements made with the Federal Reference Method (FRM) monitors. The results are shown in Tale 1.

Table 1: Annual design values for 2006 calculated using FRM measurements

Site	Code	2006 DV[1]
Bakersfield - 5558 California	BAC	18.51
Bakersfield - 410 E Planz	BEP	18.86
Bakersfield - Golden State	BGS	18.64
Clovis - N Villa Avenue	CLO	16.39
Corcoran - Patterson Avenue	COP	17.24
Fresno - 1st Street	FSF	16.68
Fresno - Hamilton and Winery	FHS	17.16
Merced - 2334 M Street	MRM	14.69
Modesto - 14th Street	M14	14.10
Stockton - Hazelton Street	SOH	12.93
Visalia - N Church Street	VCS	18.20

[1] 2006 Design Value in $\mu g/m^3$

Second, the FRM monitor does not provide chemical speciation information. Thus, it is necessary to derive the speciation characteristics of the FRM measurement using a co-located Speciation Trend Network (STN) monitor. This derivation is known as the Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbonaceous material balance approach (SANDWICH), and is described in detail in the U.S. EPA modeling guidance which can be found at *www.epa.gov/scram001/guidance_sip.htm*. The results of the SANDWICH procedure are shown in Table 2. Here NH4 stands for the ammonium ion, NO3 for the nitrate ion, SO4 for the sulfate ion, OC for the organic carbon, EC for the elemental carbon, and Crustal for crustal materials.

Table 2: Chemical composition of the 2006 annual design values

Site	Code	Derived Chemical Composition (µg/m^3)[1]					
		NH4	NO3	SO4	OC	EC	Crustal
Bakersfield - 5558 California	BAC	1.58	3.50	1.71	7.64	0.94	1.23
Bakersfield - 410 E Planz	BEP	1.61	3.56	1.74	7.79	0.96	1.25
Bakersfield - Golden State	BGS	1.59	3.52	1.72	7.69	0.95	1.24
Clovis - N Villa Avenue	CLO	1.21	2.63	1.45	7.81	0.83	0.84
Corcoran - Patterson Avenue	COP	1.53	3.19	1.66	7.23	0.49	1.37
Fresno - 1st Street	FSF	1.23	2.68	1.48	7.95	0.85	0.86
Fresno - Hamilton and Winery	FHS	1.27	2.76	1.52	8.18	0.87	0.88
Merced - 2334 M Street	MRM	1.30	2.66	1.41	6.60	0.56	0.78
Modesto - 14th Street	M14	1.24	2.55	1.35	6.33	0.53	0.75
Stockton - Hazelton Street	SOH	1.14	2.34	1.24	5.80	0.49	0.69
Visalia - N Church Street	VCS	1.62	3.37	1.75	7.63	0.52	1.45

[1] Please note that the mass of the chemical components does not add up to the design values in Table 1 because the contributions due to filter artifacts for carbon and particle bound water are not shown in Table 2.

Third, it is necessary to calculate the air quality benefits of emission reductions that are included in the plan and to project 2006 design values forward to 2014 for the modeled attainment test. The 2006 design value is derived from monitoring data for the years 2004-2006. In their modeling guidance, U.S. EPA recommends modeling the middle year of the baseline design value period, which in this case is 2005. An additional benefit of using 2005 is that it represents the base year for the emission inventory, and is used to project and backcast inventories for other years. Thus it is the year for which we have the greatest confidence. For the attainment test, U.S. EPA guidance is to model the year preceding the attainment year for attainment planning purposes; for PM2.5 this is 2014.

The air quality benefits of emission benefits included in the plan were quantified using a grid-based photochemical model from the U.S. EPA, the Community Multi-Scale Air Quality (CMAQ) model. The model was first exercised for the year 2005 and then for the year 2014 with appropriate emission reductions; the results from these model runs were used to generate relative response factors (RRFs) by the chemical components in $PM_{2.5}$. That is, for a given component the benefits of emission reductions were expressed as the ratio of 2014 concentration to the 2005 concentration. If the emission controls are beneficial for a given pollutant, then the RRF for that pollutant is less than one. The more beneficial the emission reductions, the smaller the RRF becomes. The RRFs for chemical components of $PM_{2.5}$ are shown in Table 3.

Fourth, the chemical component concentrations of the 2006 DV need to be multiplied by the appropriate RRF to derive the future-year chemical component concentrations. These future-year chemical component concentrations are then summed together with appropriate contributions from filter artifacts for carbon and particle bound water to

obtain the future-year DV as shown in Table 4. This procedure is known as the Speciated Model Attainment Test (SMAT) which is detailed in the $PM_{2.5}$ modeling guidance.

Table 3: Annual Relative Response Factors based on the CMAQ model

Site	Code	Relative Response Factors					
		NH4	NO3	SO4	OC	EC	Crustal
Bakersfield - 5558 California	BAC	0.66	0.59	0.94	0.77	0.64	0.83
Bakersfield - 410 E Planz	BEP	0.66	0.59	0.93	0.78	0.64	0.84
Bakersfield - Golden State	BGS	0.66	0.59	0.94	0.77	0.64	0.83
Clovis - N Villa Avenue	CLO	0.70	0.60	1.02	0.77	0.64	0.86
Corcoran - Patterson Avenue	COP	0.60	0.53	0.99	0.81	0.71	0.94
Fresno - 1st Street	FSF	0.69	0.58	1.01	0.79	0.64	0.87
Fresno - Hamilton and Winery	FHS	0.69	0.58	1.02	0.79	0.65	0.88
Merced - 2334 M Street	MRM	0.71	0.63	0.99	0.79	0.65	0.89
Modesto - 14th Street	M14	0.76	0.66	1.01	0.82	0.70	0.91
Stockton - Hazelton Street	SOH	0.75	0.69	1.00	0.79	0.73	0.91
Visalia - N Church Street	VCS	0.61	0.55	0.99	0.80	0.67	0.99

Table 4: Annual design values for 2014 calculated using the SMAT procedure

Site	Code	2014 DV[1]
Bakersfield - 5558 California	BAC	14.28
Bakersfield - 410 E Planz	BEP	14.70
Bakersfield - Golden State	BGS	14.39
Clovis - N Villa Avenue	CLO	12.72
Corcoran - Patterson Avenue	COP	13.27
Fresno - 1st Street	FSF	13.01
Fresno - Hamilton and Winery	FHS	13.47
Merced - 2334 M Street	MRM	11.76
Modesto - 14th Street	M14	11.44
Stockton - Hazelton Street	SOH	10.87

[1] 2014 Design Value in $\mu g/m^3$